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IV. The Description of an Apparatus for impregnating Water with fixed Air; and of the Manner of conducting that Process. By John Mervin Nooth, M. D. F. R. S.

Redde, Dec. 15, 1774. **T**HE possibility of impregnating water with fixed air was no sooner ascertained, by experiment, than various methods were contrived to effect the impregnation. The ingenious Dr. PRIESTLEY, however, is the only one that has published any description of an apparatus, calculated intirely for this purpose. This apparatus was communicated to the public, with the view of promoting the discovery of the medical effects of fixed air united with water; and, in consequence of this communication, some very successful attempts have been made in the cure of diseases. The experiments, however, have not been so numerous as one could have wished; perhaps the difficulty in conducting the process, in the manner proposed, has been, in some measure, the reason why so few experiments, on this subject, have been made public. For although, in the hands of the doctor, the apparatus was sufficiently convenient, it must be confessed, that the conduct of the process required more address than generally falls to the share of those that are unaccustomed to such experiments. Independent too of the inconveniences attending the process, there was another

objection to the apparatus, which, with most people, might have considerable weight. The bladder, which formed part of it, was thought to render the water offensive; and when the solvent power of fixed air is considered, it will not appear improbable, that the water would be always more or less tainted by the bladder. In some trials which I made with Dr. PRIESTLEY's apparatus, it always happened, that the water acquired an urinous flavour; and this taste in the water was, in general, so predominant that it could not be swallowed, without some degree of reluctance. The difficulty, therefore, in the conduct of the process, and the offensiveness of part of the apparatus, made some less exceptionable method of producing the impregnation desirable. This I variously attempted, keeping convenience and cleanliness constantly in view; and I flatter myself, that I have at last contrived an apparatus that will perfectly answer the intended purpose. It is now twelve months since this contrivance has been in constant use; and hitherto there is no reason to wish for the least alteration. Presuming, therefore, on the possibility of its becoming, when known, extensively useful, and convinced of the favourable reception which every attempt of this nature meets with from the Royal Society, I beg leave to communicate to them a description of the apparatus that I have invented, and of the manner of conducting the process.

DESCRIPTION

DESCRIPTION OF THE APPARATUS;

which is of glass, and consists of three vessels as (A, B, C), fig. 1. 2. 3. The glasses are accurately fitted to each other, and at the joints are impervious both to air and water. The glass (A) is designed for the effervescing substances. The vessel (B) is to contain the water that is to be impregnated with air. In the lower part of the glass (B) is placed an ivory valve, surrounded with cork, as in fig. 4. The cork (*a*) is fitted to the bottom of the glass (B), and has through it an hole, to receive the part (*b*) of the ivory valve. On the broader part of this piece (*b*) is placed a moveable piece (*c*). The surfaces of these pieces are so accurately ground, that, when applied to each other, no fluid whatever can pass between them. The moveable part (*c*) is secured on the part (*b*) by the cover (*d*), which is so constructed, as to allow the piece (*c*) some motion, and this cover has likewise holes to give passage to the air that shall raise the moveable piece (*c*). The glass (C) serves two purposes; it confines the air on the surface of the water in (B), and at the same time prevents all danger of explosion by allowing the water to give place to the ascending air.

THE PROCESS.

As chalk and oil of vitriol are capable of producing the desired effervescence, and are the most eligible on account of their cheapness, I shall, in describing the process, mention only these two ingredients. Variety of other substances

substances may, however, be employed for the same purpose; but none, perhaps, are so unexceptionable as those I have named. In the other acids a proper degree of fixity is wanting, during the effervescence; the nitrous and marine have so much volatility that there is always a risk of some of the acid fumes passing the valve, and thus rendering the water acid, which it was intended to impregnate only with fixed air. To begin the process, it is necessary to fill the vessel (A) up to the dotted lines, with diluted oil of vitriol. By confining the height of the surface of the effervescing mixture to the dotted lines in the glass (A), none of the acid will be driven through the valve, during the intumescence that attends the escape of the fixed air. The glass (B) is to be totally filled with water, and the vessel (C) is to be put on it. Some powdered chalk is then to be thrown into the glass (A), and the vessels are to be immediately placed as in fig. 5. except that the stopper belonging to (C) is to be left out. When the acid, in the lowermost vessel, acts on the chalk, the extricated air passes the valve in the middle glass; and as the construction of this valve allows the fixed air from the effervescing substances to pass, but denies a passage to the water in a contrary direction, the separated air ascends to the upper part of the middle glass, and at the same time a portion of water, equal in bulk to the intruding air, passes up the bent tube into the uppermost vessel. As the effervescence goes on, the fixed air continues to accumulate in the middle vessel, and the uppermost one to be filled

filled with the water that has given place to the air. The quantity of chalk to be thrown into the acid at one time, must be determined by the capacity of the uppermost vessel. Should more air be extricated than is sufficient, in the conduct of the process, to fill that vessel, the water will run over the top of it, and will continue to run as long as any air ascends in the middle vessel, or till the surface of the water is below the extremity of the bent tube. Both these accidents are to be carefully avoided; as in one case, the whole would be wet and disagreeable; and in the other, a quantity of fixed air would be unnecessarily lost. Half a dram of chalk will, in general, produce air enough to fill the uppermost vessel with water; and it must be remembered, that the chalk employed to produce the effervescence, should be finely powdered, as a selenitic crust will otherwise form around it, and thus prevent the action of the acid on the interior part. To keep the neck of the glass clean, through which the chalk is put, it will be necessary to include the chalk loosely in paper; and this circumstance is by no means to be neglected, as the accurate junction of the glasses depends on it, and consequently the whole of the process. When the uppermost vessel is filled with water, and there is, therefore, a considerable quantity of fixed air in the middle one, these two vessels are to be separated from the lowermost, and the air and water are to be agitated together, to promote their union. If, during the agitation, a stopper be put into the uppermost glass, the descent of the water in it will not shew the absorption of the fixed
 air

air by the water, as the external atmospherical air will enter below, at the valve, to fill the space which the absorbed fixed air would otherwise leave void. But, on the contrary, if the uppermost vessel be open, during the agitation, the pressure of the atmosphere on the surface of the water in that vessel, will force the water down into the middle one, as fast as the absorption of the fixed air below will allow it room. This latter method may be pursued, when a person wishes to know the quantity of fixed air that the water can absorb; but in common use, it will be better to stop the uppermost vessel, as the air and water may be then more forcibly agitated without inconvenience, and of course, the impregnation more expeditiously effected. During the effervescence, the uppermost glass is to remain open, and it is only to be stopped when the agitation is performed. It is not to be expected, that the impregnation will be considerable at first; it will indeed be necessary to repeat the process, with the same water, four or five times, before it will be highly impregnated. After an agitation, therefore, when a stronger impregnation is wished for, the uppermost vessel is to be opened, and raised from the middle one, to allow the water to descend, that was before driven up. When the middle glass is again full, a fresh quantity of chalk is to be put into the lowermost vessel, and the agitation to be repeated, as soon as the effervescence ceases. It is seldom necessary to repeat the process more than four times, to produce a very strong impregnation; but should it be thought proper, to have the water as highly

saturated

aturated with fixed air as it admits of, nothing more than a repetition of the same process is requisite. In this account of the apparatus, I have purposely confined myself to the method of uniting fixed air with water; but it is to be observed, that many curious experiments may be made with it, both in chemistry and pharmacy. By its assistance, I have been enabled to imitate very perfectly, the common mineral waters, and to make aqueous solutions of substances that were before deemed insoluble in water. These circumstances, however, I shall reserve for a future paper, which I shall have the honour to present to the Society, as I have not yet been able to arrange the several facts, which this apparatus has made me acquainted with, in the manner I could wish.

P O S T S C R I P T.

SINCE the foregoing paper was read, I have contrived a glass valve, which seems preferable in some respects to the ivory one therein described. The following is a description of it. It consists of three pieces, as in fig. 7. The superior and inferior pieces are perforated, but the middle one is without perforation, having only its upper part convex and its under part plane. In fig. 8. is a perpendicular section of the three pieces composing the valve, at the distance at which they ought to be placed, with respect to each other, in the tabular part of the vessel (B). This vessel having the glass valve in it, and filled with water, is to be put on the glass (A),

containing substances in the act of effervescence. In that case, the extricated air will ascend through the perforations in the superior and inferior pieces, the middle one proving no obstacle to the air, having sufficient room to yield to the current of air rushing upwards; but when the air ceases to ascend, and the pressure of the water above takes place, the middle piece will prevent the water from descending, its plane surface being then applied to the plane surface of the piece below it. Thus, SIR, this glass valve will answer in every case where the ivory one can be employed; and for a variety of purposes it will undoubtedly prove preferable, particularly when corrosive substances are subjected to experiment.

Fig. 6.



Fig. 5.

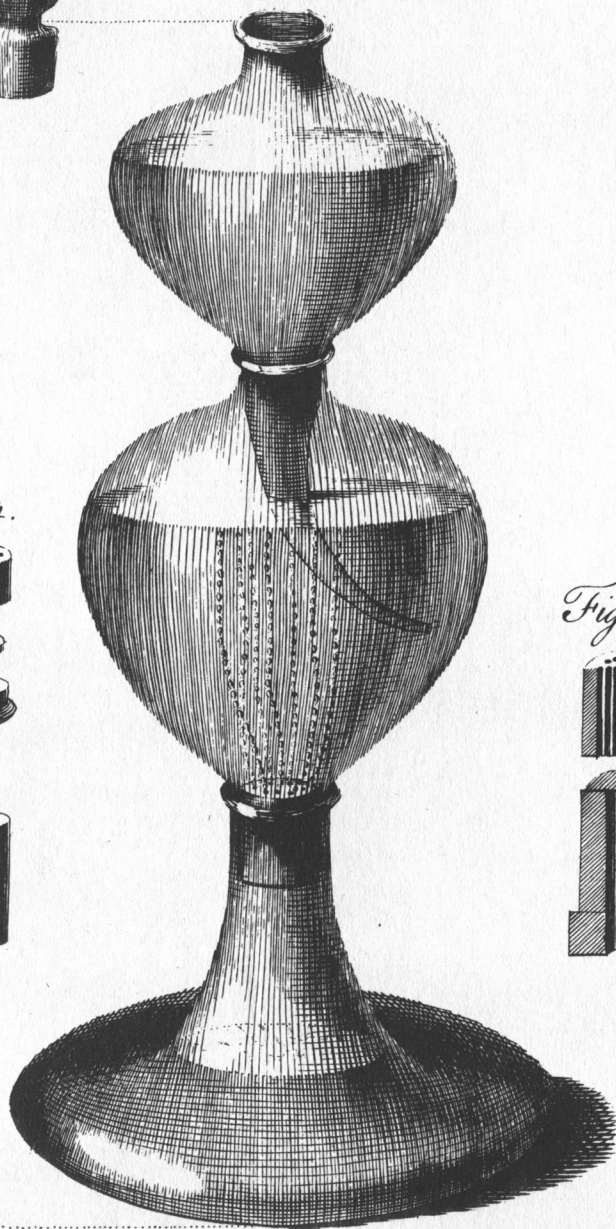
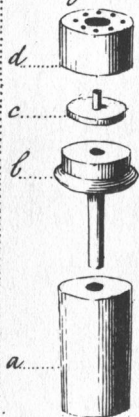


Fig. 4.



17 1/2 high

Fig. 3.

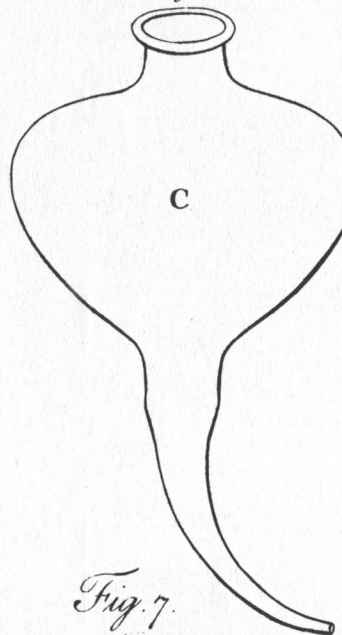


Fig. 8.



Fig. 7.



Fig. 3.

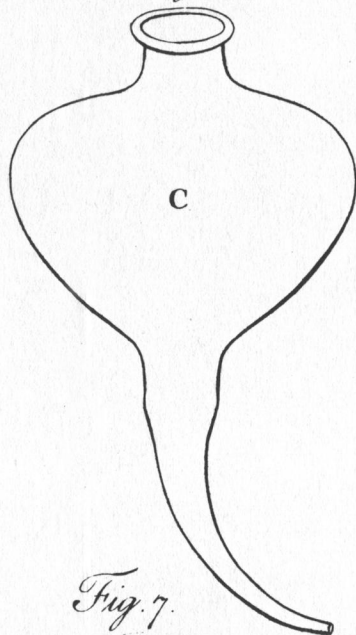


Fig. 2.

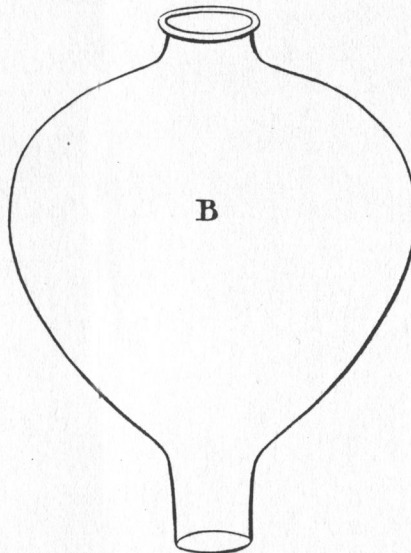


Fig. 8.



Fig. 7.



Fig. 1.

